

REMARKS

Applicants have amended claim 24, cancelled claims 26, 27, and 31, and added claim 35. Claims 24 to 25, 28 to 30, and 32 to 35 are pending with claim 24 being independent. No new matter has been added. In particular, claim 24 has been amended to incorporate subject matter from cancelled claims 26, 27, and 31. Additionally, support for the subject matter claimed in claim 24 exists in the application at Figure 3 (showing a first cladding layer with a ridge, the ridge having a first width; a defined gain region having a second width greater than the first width; and reduced conductivity regions flanking the defined gain region), in the specification at page 11, line 21 to page 12, line 1 (stating that in an embodiment of the invention, only sections of the active layer on the sides of the ridge are implanted with high energy protons to produce reduced conductivity regions), and in the specification at page 9, line 6 to page 11, line 7 (stating that the defined gain region is sized to support only the fundamental mode of laser light and that other modes are not amplified and decay because the reduced conductivity regions are placed sufficiently close to the light amplification portion of the active layer). Support for the subject matter claimed in claim 35 exists in the application at page 7, lines 20-21.

35 U.S.C. § 103

Claims 24-31 and 33-34 have been rejected as allegedly anticipated by Beernick et al. (U.S. Patent No. 5,717,707) in view of Sun (U.S. Patent No. 6,044,098). Applicants request that this rejection be withdrawn because neither Beernick nor Sun disclose or suggest the subject matter of independent claim 24.

Independent claim 24 recites a ridge waveguide semiconductor laser having a first cladding layer with a ridge and an active layer with a defined gain region and ion-implanted reduced conductivity regions flanking the defined gain region. The ridge has a first width at the bottom of the ridge and the defined gain region has a second width greater than the first width. The second width is selected such that the defined gain region supports a fundamental lateral mode of the light, while higher order modes are not supported due to their overlap with the reduced conductivity regions.

The Office Action alleges, "in many applications a ridge waveguide laser and a buried heterostructure laser may be interchangeable" (at page 3). The Action then continues, "[s]ince it has been shown that it is well known that either structure may be used, then an embodiment of Beernick where the laser structure is a ridge-waveguide type would have been an obvious variant of the buried heterostructure laser of Beernick" (id.). The Action then asserts that Sun provides evidence that ridge wavbeguide type lasers may be advantageous.

Applicants respectfully submit that the Office Action fails to establish a *prima facie* case of obviousness. In particular, the Office Action does not identify any suggestion in the cited prior art to modify Beernick's buried ridge type laser to make applicants' claimed ridge waveguide semiconductor laser diode. The assertion that both types of lasers can be used interchangeably in various applications, even if true, has nothing to do with whether a ridge type laser is obvious in view of a buried ridge laser. The interchangeability provides no suggestion or motivation to alter or modify Beernick's laser. Furthermore, the suggestion in Sun that ridge waveguide lasers may be advantageous over buried heterostructure lasers also provides no motivation to modify Beernick's design. All it does it is to tell a reader that they should use a ridge waveguide laser, but not applicants' claimed ridge waveguide semiconductor laser diode. Absent such suggestion and motivation, the alleged conclusion of obviousness cannot stand.

Furthermore, neither Beernick nor Sun disclose or suggest a ridge waveguide semiconductor laser having a defined gain region with a particular width and flanking ion-implanted reduced conductivity regions where the particular width is selected such that the defined gain region supports a fundamental lateral mode of the light but higher order modes are not supported due to their overlap with the reduced conductivity regions.

The Office Action states that the limitations of claims 26 and 27, which have been incorporated into amended independent claim 24, are inherent in Beernick. Applicants respectfully disagree. The particular width of the defined gain regions and the flanking reduced conductivity regions must be chosen carefully to support the fundamental mode, but to suppress higher order modes. Indeed, the application states (at page 10, line 18 to page 11, line 2):

The location within active layer 10 of reduced conductivity regions 26 must be selected carefully. The width of the defined gain region 24 of active layer 10

determines which lateral modes of the laser light will be supported, therefore reduced conductivity regions must be placed sufficiently close to the light amplification portion 30 of active layer 10, so that additional modes will not be sustained by the active layer 10.

In contrast, Beernick is unconcerned with the particular width of a defined gain region. Beernick attempts to solve the problem of current leakage around the gain region from a top contact through an impurity-induced layer disordering ("IILD") region to a bottom contact (see, e.g., col. 1: 49 to col. 2:14). Beernick discloses several methods and structures that solve this problem. However, Beernick does not disclose or suggest that the width of a defined gain region and flanking reduced conductivity regions within an active layer is selected such that the defined gain region supports a fundamental lateral mode of the light, while higher order modes are not supported due to their overlap with the reduced conductivity regions. Nor is the selection of a particular width inherent in Beernick. In addition, Beernick fails to suggest modifying his buried heterostructure laser design to form a ridge waveguide laser.

Sun does not cure the defects of Beernick. Sun relates to a ridge waveguide semiconductor laser having an active region confined by an oxide layer. The width of the active region can be narrower than the width of the ridge to reduce the threshold current and reduce the higher order modes (col. 6:3-7). However, the narrow width of the active region is achieved by underetching the ridge and growing an oxide layer adjacent to the active region. Thus, Sun does not disclose or suggest an ion-implanted reduced conductivity region flanking a defined gain region. Sun also does not disclose a defined gain region having a width wider than the width of the ridge, where the width of the defined gain region is selected such that the defined gain region supports only a fundamental lateral mode of the light. Indeed, the cited references teach away from an ion-implanted reduced conductivity region having such a width.

For example, Nagai relates to semiconductor lasers operating near threshold current. Nagai is concerned with stabilizing the horizontal transverse mode of the laser, see col. 2:20-37, and, more particularly, with reducing the kink in the intensity-current curve that appears near threshold current, see col. 8:17-46. Nagai states this object can be achieved by reducing the width of the ridge preferably to not more than 3 microns (col. 2: 33-37). However, according to

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Nagai in practice such a width cannot be fabricated because it would result in a ridge having a triangular shaped ridge without a top surface on which to apply a conductive layer, so, Nagai states, “[a]ccordingly, it is impossible to prevent a higher mode from being generated and to stabilize the horizontal transverse mode by reducing the width of the ridge waveguide” (col. 2:38-53). To achieve his objective, Nagai discloses a ridge waveguide semiconductor laser with disordered regions defining an opening in the active layer that is significantly narrower than the width of the ridge (See, Nagai Fig. 3; col. 4:37-54; col. 7:6-22). However, Nagai does not describe or suggest that his objective could be achieved in a laser having an active region with a width that is greater than the width of the ridge. Thus, the cited reference teaches away from the claimed invention, which requires a ridge laser having a defined gain region with a particular width and flanking ion-implanted reduced conductivity regions where the particular width is selected such that the defined gain region supports a fundamental lateral mode of the light, but higher order modes are not supported due to their overlap with the reduced conductivity regions.

For at least these reasons, applicants respectfully request allowance of claim 24. Claims 25-35 depend from claim 24 and are allowable for at least the reasons that claim 24 is allowable.

Enclosed is a check for the Petition for Extension of Time fee. Please apply any other charges or credits to deposit account 06-1050.

Respectfully submitted,

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